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F. G. BRICKWEDDE RECEIVES HILLEBRAND PRIZE

The annual Hillebrand Prize of the Chemical Society of Washington was awarded on the evening of March 13 to F. G. Brickwedde, chief of the Bureau's Cryogenics Section, for his work on deuterium and its compounds with special reference to the preparation and determination of the properties of hydrogen deuteride, a molecule consisting of one atom of hydrogen and one of deuterium ("heavy hydrogen"), and having the chemical symbol HD.

Dr. Brickwedde was presented by Raymond M. Hann, and the award was made by H. J. L. Haller of the Department of Agriculture, president of the Society, and a former recipient of the prize.

REVISED STANDARD FREQUENCY BROADCASTS

Immediately after the Bureau's standard frequency station, WWV, was destroyed by fire on November 6, 1940, (Technical News Bulletin 284, December 1940), a transmitter was established in another building and partial service was begun. The service has now been extended, although still with temporary equipment. Except for possible breakdowns, it will be on the air continuously at all times day and night, and carries the standard musical pitch and time intervals. The radio frequency is, as before, 5 megacycles (=5,000 kilocycles= 5,000,000 cycles) per second.

The standard musical pitch is the frequency 440 cycles per second, corresponding to A above middle C. In addition, there is a pulse every second, heard as a faint tick when listening to the 440 cycles. The pulse lasts 0.005 second and provides an accurate time interval.

The 440-cycle tone is interrupted every 5 minutes for 1 minute, to give the station announcement (WWV in telegraphic code) and to provide an interval for checking radio measurements.

The accuracy of the 5-megacycle frequency, and of the 440-cycle standard

[1] Published with approval of the Director of the Budget.

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pitch as transmitted, is better than a part in 10,000,000. Transmission effects in the medium (Doppler effect, etc.) may result in slight fluctuations in the 440-cycle frequency as received at a particular place; the average frequency received is, however, as accurate as that transmitted. The time interval marked by the pulse every second is accurate to 0.000,01 second. The 1-minute, 4-minute, and 5-minute intervals marked by the beginning and ending of the announcement periods are accurate to a part in 10,000,000. The beginnings of the announcement periods are so synchronized with the basic time service of the U. S. Naval Observatory that they mark accurately the hour and the successive 5-minute periods; this adjustment does not have the extreme accuracy of the time intervals, but it is within a small fraction of a second.

The broadcast is from a 1-kilowatt transmitter. It is most useful for moderate distances in the daytime and long distances at night. For reception in locations reasonably free from interference, it is receivable in the summer at all distances up to about 500 miles from Washington in the middle of the day. The distance range increases after about 4 P. M. (EST) until at night the broadcast is receivable throughout the United States (i. e., the 5-megacycle carrier frequency; the 440-cycle tone is sometimes not receivable at night beyond about 1,300 miles). Sometimes at night it may be difficult to receive either the 5-megacycle or the 440 cycles at distances between about 50 and 500 miles, while it is easy to receive them beyond 500 miles. In the autumn the daytime distance range will increase, rising to about 1,000 miles in the winter.

The service from the temporary transmitter will continue until the Bureau can establish a new station to provide more fully than in the past, standard frequencies reliably receivable at all times throughout the country. These will be transmitted on more adequate power, and several radio carrier frequencies will be used, in order to provide more certain coverage of all distances and times.

SENSITOMETRIC METHOD OF EVALUATING BLUEPRINT PAPERS

The sensitometric method of measuring the quality of photographic materials has been applied by Raymond Davis and G. K. Neeland to a study of various kinds of commercial blueprint paper. Different portions of a sample of paper were exposed to light for a series of increasing times in an instrument called a sensitometer. The exposed samples were then washed, placed in a bichromate bath, washed again, and dried. The resulting series of color steps, ranging from white to dark blue, was measured by determining the amount of light reflected from each exposed area. This was done with an instrument known as a densitometer, and the readings are known as reflection densities. When these readings are plotted against the logarithm of the corresponding exposure times, a characteristic curve is formed, which is somewhat different in shape for each kind of material. From these differences, one may predict the performance of the material.

The changes that take place in the charactertistics of papers when stored under various conditions have been determined, and it has been found that the rate of change may be different for two kinds of paper, even when they are both stored under the same conditions.

Likewise, the characteristics of different grades of paper of the same make may differ by small amounts. Inspection of a set of sensitometric curves for such a group would give the manufacturer a more precise picture of the quality of the different coatings. In some cases this might result in a smaller number of grades being offered, a simplification that would benefit maker and user.

PROTECTION OF DOCUMENTS WITH CELLULOSE ACETATE SHEETING

The lamination of paper with cellulose acetate sheeting, a process developed at the Bureau for the protection of documentary material, is being quite extensively practiced. A further investigation has now been made to ascertain the quality of the sheetings being used by different operators and the efficacy of their processes.

Identical papers representing the types generally used for documents were sent to six commercial concerns and The National Archives of the United States, who laminated the papers with sheeting and returned them, together with samples of the sheeting used, to the Bureau for test. It was found that three of the operators used plain sheeting and applied it to the papers with heat and pressure, one used sheeting coated with an adhesive and also applied it with heat and pressure, and the

others used sheeting containing an adhesive but applied it with pressure only. The sheetings represented the products of three manufacturers who make special types for the purpose.

The sheetings were tested for chemical and physical properties which are related to laminating quality, resistance to wear, and stability. They were all found to be very satisfactory. They had high strength and were apparently as stable as the best grade of papers made for permanent records.

The workmanship of the laminated papers was good. The sheetings were applied smoothly, and they could not be removed without splitting the papers. Tests showed that the stability of the papers had not been adversely affected. To obtain indications of the permanence of the bond, the samples were subjected to extreme changes in moisture content and were baked at a high temperature. The bond of nearly all of them remained intact under the varied changes in moisture content. When the samples were heated for 72 hours at 100° C, the bond was loosened in many cases, but the fact that a large number remained unaffected by this severe treatment is evidence that a very high degree of stability of the bond can be attained. The sheeting of many of the samples yellowed somewhat under the heat test, but the majority were not affected by this treatment.

In addition to its high strength and stability, the acetate sheeting is transparent, thin, easily cleaned with water, and is resistant to insects. Furthermore, the laminating process is speedy and is excellent for mending documents.

The complete report of this investigation has just been released as Miscellaneous Publication M168. The price is 5 cents.

UNUSUAL FAILURES OF STOCKINGS IN SERVICE

The unprecedented epidemic of runs in women's stockings which occurred in Washington, D. C., on February 18, 1941, led the Bureau to make a study of the damage. Although hundreds of stockings which have failed in ordinary service are examined in the Textile Section each year, none has exhibited the characteristics associated with the failures of the stockings in the Washington epidemic. Both new and old silk and nylon hosiery from different manufacturers and different retail stores suffered alike.

The damaged stockings exhibited numerous runs which, according to the wearers, appeared suddenly and all about the same time. The breaks responsible for these runs occurred predominantly in the ankle and lower part of the leg fabric, though they were also found elsewhere in the stockings. Dark specks of matter could be seen with the unaided eye at most of the breaks.

Microscopical examination and tests of the particles showed them to be dark, granular, organic matter, definitely not resembling particles of sand or coal. They clung to the fibers at or near the breaks. The broken fibers clearly had been acted upon by a chemical at the point of rupture, and had none of the characteristics of fibers which have been severed by cutting or abrasion. Chemical tests showed fibers to be strongly acid in the vicinity of the particles, but not elsewhere. Analyses showed sulfuric acid, possible sources of which in city air include the products of combustion of coal, fuel oil, and gas, automobile exhaust gases, and spray from the overcharging of storage batteries.

Some fine particles obtained by sifting cinders were thoroughly wet with a dilute solution of sulfuric acid, warmed to concentrate the acid, and then sprinkled on silk and nylon stockings. After about 5 minutes, holes and runs resembling those in the damaged stockings were formed.

The failure of the stockings in service is attributed to the action of sulfuric acid carried into them on air-borne particles. Several women observed black particles on their hands and faces and felt a stinging sensation such as would be caused by the acid. It seems significant that most of the complaints, of which there were an estimated 400 or 500 on February 18 and 19, came from women who passed through a restricted downtown area. The trouble recurred in a milder form on March 2, 3, and 4, on March 9, and on March 16, 17, and 18, with the complaints coming from the same area. The source of the acid particles, which evidently is a local one, has not been discovered.

ELECTROPHORETIC STUDIES OF NYLON

The development of new synthetic textile fibers frequently makes it necessary to alter common industrial practices. Thus, new fibers may require new types of scouring, dyeing, or finishing agents, depending on the nature of the material. A well-known example of this was the necessity of developing entirely new types of dyestuffs for cellulose acetate fibers. That the development of nylon has also presented new problems is not surprising since its chemical and physical properties are

very different from those of any of the other commercially important fibers. A number of these problems, such as those involving finishing treatments, are dependent in part on the nature of the surface of the fibers, and more especially on their surface electrical properties. Accordingly, an investigation was undertaken by Milton Harris and Arnold M. Sookne, Research Associates of the Textile Foundation at the Bureau, to evaluate the surface electrical properties of nylon by the microelectrophoretic technique as previously used by them for studying similar properties of wool, cotton, and silk.

Two types of nylon, "unoriented" and "oriented", were used in the investigation. The latter is prepared by stretching the former approximately fourfold in length, and constitutes the fiber which is used commercially. It was found that both types of materials exhibited definite reversals of charge, but at different pH values; the unoriented fiber at pH 3.9 and the oriented at pH 2.7. Since nylon consists of hydrocarbon chains linked together by amide groups, it appears that reversal of charge is principally dependent on the presence of the amide groups, especially since hydrocarbons do not exhibit reversal of sign of charge under comparable conditions. This suggests that amide groups may also influence the electrophoretic behavior of other substances, such as proteins. The difference in the electrophoretic behavior of the two types of nylon is attributed to the difference in their degrees of "crystallinity"; that is, to the degree with which the long chain molecules are lined up in parallel arrangement. The complete report of this work will be published as RP1376 in the April number of the Journal of Research.

AFFINITIES OF ACIDS FOR WOOL PROTEIN

The fastness of wool dyes to washing varies widely, not only among different classes of dyes, but even among members of a given class. These variations are manifestations of the differences in affinities of the dyestuffs for the fibers. A possible basis for understanding such differences was described in two earlier papers (J. Research NBS 25, 519 (1940), RP1343; and 26, 71 (1941) RP 1360), in which it was shown that wool imersed in hydrochloric acid solutions combines not only with hydrogen ions but with chloride ions as well. As a consequence of this, it appeared that the affinities for wool of the anions of different acids might vary considerably and that, therefore the positions of the titration curves with respect to the pH axis might vary by correspondingly large amounts, according to the acid used. The determination of the titration curve of wool with a given acid could then be used to measure the affinity of the anion of the acid for the fiber.

Measurements of the combination of wool with 19 different acids have, therefore, been made at the Bureau by Jacinto Steinhardt, Charles H. Fugitt, and Milton Harris, Research Associates of the Textile Foundation. In addition to some of the common mineral acids, several of the simpler aromatic sulfonic, carboxylic, and phenolic acids and a soluble mono-azo acid dye were included. As reported in the April number of the Journal of Research (RP1377), wide differences were found between the positions of the resulting nineteen titration curves. A generalized form of the equations previously developed to account for the effect of the concentration of chloride ion on the amounts of hydrochloric acid combined, was utilized to calculate the affinity for wool of each of seventeen anions involved. Predictions based on the equations, as to the effects of variations of anion concentrations and of temperature were tested and confirmed.

Measurements of the combination of a number of the same acids with a soluble protein—crystalline egg albumin—were also made. Since qualitatively similar differences in the corresponding titration curves were found with both proteins, it is concluded that the property of combining with anions is not restricted to insoluble proteins, such as wool, but is an inherent property of proteins in general. The affinity of the anions appears to increase with their dimensions, and is higher in aromatic than in aliphatic ions of the same size. These relationships are used as the basis of a consideration of the nature of the forces involved in the binding by proteins of anions, including the anions of acid dyes.

STABILITY OF FIBER SHEATHING BOARDS

Accelerated aging tests—used at the Bureau to find the lasting qualities of fiber sheathing boards—are described in Building Materials and Structures Report BMS69, which has just been released. This method of determining stability has been found to produce, in a short time, effects comparable to those from long periods of natural aging, and

makes possible a prediction of the performance of the material without waiting years for a service trial. It has been found particularly useful for testing paper, fiberboards, and other cellulosic materials.

The new type of fiberboards are used as sheathing on frame construction, and under brick veneer and stucco. They are of about the same formation and density as the fiber insulating boards, but are made more resistant to the passage of air and water and are $^{25}/_{32}$ inch thick, the same as the lumber usually employed for sheathing.

In general, the fiber sheathing showed good resistance to aging, although there were variations in quality among the commercial products. Some of the most important properties of the boards, including insulating value and the resistance to the passage of air and water, were little affected by the aging treatments, and the retention of strength after aging was, in most instances, high. The boards were relatively resistant to the action of rot-producing fungi found most commonly around wood construction.

Copies of BMS69 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

SOLAR HEATING OF VARIOUS SURFACES

As one phase of its low-cost housing research, the Bureau has studied protection against summer heat. The present concept of a low-cost house precludes the use of mechanical air cooling or dehumidifying devices on account of their cost. Instead, means for maintaining summer comfort must be restricted to insulating the ceiling or roof, using adequate shading devices for windows, and selecting paints and surface coverings which reflect most of the sunlight and tend to remain cool.

Building Materials and Structures Report BMS64, just released by the Bureau, contains the results of a study of the reflective properties of house paints and surface coverings. Panels covered with white paints were found to be coolest, and one covered with lampblack, the warmest when exposed to the sun. Paints of other colors were found to be intermediate between white and black in the protection they afforded against solar heat. Surfaces covered with light shades of paints, such as those commonly used for walls, were found to be only somewhat warmer than those covered with white paints, but a dark trim color was found to be nearly as warm as the black surface.

Copies of BMS64 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

HEATS OF HYDRATION OF PORTLAND CEMENTS

Portland cement generates considerable heat in hardening. This is of great concern in the placing of large masses of concrete, such as was used in the construction of Boulder Dam. This heat of hydration, if not reduced or removed in some way, causes high temperatures to develop in the interior of the concrete mass, which, on cooling will shrink and may cause cracking. In the case of Boulder Dam, in addition to mechanical cooling by means of cold brine circulating through pipes set in the concrete, special cements having low heats of hydration were used.

A precision calorimeter costing several thousand dollars was used by the Bureau to measure the heat of hydration of these cements. This was measured by subtracting the heat of solution of the hydrated cement from that of the unhydrated cement. More than 5,000 determinations of the heat of solution of the cements that went into Boulder Dam were made with this apparatus. More recently a simpler apparatus, consisting essentially of a jacketed vacuum flask, a Beckmann thermometer and a motor driven stirrer (total cost less than one hundred dollars) has come into use among cement testing laboratories.

Since the use of this apparatus has been made a part of certain Federal specifications, a knowledge of the reproducibility of heats of solution determined with it seems desirable. A study of the reproducibility of results obtained with the vacuum-bottle calorimeter was recently completed, 12 determinations of heat of hydration having been made on each of 5 different cements. It was found that in half of the cases the difference between any two determinations of the heat of hydration of the same cement did not exceed 1 calorie per gram. As a larger number of cases is included, the maximum differences increase. In 66 percent of the cases the maximum difference did not exceed 1.5 calories, and in 95 percent of the cases the maximum difference was less than 2.9 calories per gram. This degree of reproducibility compares favorably with that of the physical methods used in cement testing.

MANOMETRIC GAS ANALYSIS APPARATUS

In the April number of the Journal of Research (RP1380), Martin Shepherd and E. O. Sperling describe apparatus designed for the analysis of gas mixtures under the following conditions: (1) When the volume of the sample is small—of the magnitude of 5 to 0.5 ml—and a reasonably accurate analysis is desired; (2) when the volume of the sample is of the order of magnitude of 0.2 to 0.1 ml, and an approximate microanalysis is desired; and (3) when the gases to be analyzed are dissolved in some liquid from which they must be liberated prior to analysis, as in the analysis of blood gases.

The apparatus is adapted for use with the admirable procedures of Van Slyke. The present design eliminates the two principal errors inherent in the Van Slyke apparatus, as well as the mechanical shaking, which some have found to be an objectionable feature By extending the apparatus here described, analysis by combustion may be performed, and greater operating conveniences achieved if desired.

APPARATUS FOR GRAVIMETRIC DETERMINATION OF CONSTITUENTS OF A GAS MIXTURE

Apparatus designed by Martin Shepherd and Harry W. Bailey, and described in the April Journal of Research (RP1381), eliminates many of the undesirable features of certain types of "absorption trains" which are intended to remove constituents from gas mixtures or to determine them gravimetrically. It is adaptable to many uses, since auxiliary units, such as combustion apparatus, etc., may be connected by means of interchangeable joints.

VOLUMETRIC GAS ANALYSIS APPARATUS

In 1931 the Bureau published a description of an apparatus for the volumetric analysis of gases by absorption and combustion (BS J. Research, 6, 121 (1931) RP266). During the past 10 years, this apparatus has become a commercial article and is used industrially. Certain modifications of the original apparatus, which have been found to add to its usefulness, are described in a paper (RP1382) by Martin Shepherd, which will be published in the April number of the Journal of Research.

QUENCHING OF HEAT-TREATED ALUMINUM ALLOY

The rate of cooling in the heat treatment of an aluminum alloy of the duralumin type has a very important influence on some of the characteristics of the finished material, particularly its corrodibility. At the Bureau, Hugh L. Logan has calculated cooling rates from photographically recorded time-temperature cooling curves obtained by means of an Einthoven string galvanometer connected in series with a thermacouple that was peened into the specimen. A commercial aluminum alloy (Aluminum Company of America, alloy designated 24S) having the nominal composition, Cu 4.4, Mg 1.5, and Mn 0.5 percent was used in this study. Specimens of this sheet material were quenched from the solution heat-treatment temperature, 493° ±5° C, in water at temperatures ranging from 22° to 100° C. Susceptibility to intercrystalline corrosion was determined, after age-hardening at room temperature, by metallographic examination of samples exposed to accelerated corrosion in an oxidizing sodium chloride solution. As shown in the report on this work, which will be published as RP1378 in the April Journal of Research, specimens cooled through the range 485° to 120° C at a rate in excess of 1,100° C per second were immune to intercrystalline corrosion. Comparison specimens cooled at rates less than 400° C per second were severely attacked along the grain boundaries. Specimens cooled at intermediate rates (400° C per second to 1,100° C per second) contained intercrystalline corrosion extending from pitted areas. The cooling rate necessary to render the material immune to intercrystalline attack of any degree was markedly affected by the copper content of the alloy and increased with an increase in the copper content. The time required to transfer the specimen under treatment, from the furnace to the quenching bath, must be so short that the temperature of the specimen does not fall below 400° C before it enters the cooling bath. Materials cooled to some temperature below 400° C before quenching were susceptible to severe intercrystalline attack no matter how rapidly the specimens were subsequently cooled.

FREEZING TEMPERATURE OF IRONS AND STEELS

The wide variety of purposes for which irons and steels are used makes

their properties of the greatest importance. Furthermore, numerous alloys with special properties are required to satisfy the needs of modern industry. It is for this reason that the effect of various impurities and alloying elements upon the properties of iron is of such great interest. The effect of such constituents upon any property of pure iron can be established only after the value of that particular property has been determined. One property, which is of particular interest to those investigating or producing iron or steel, is the melting or freezing point.

The freezing temperature of high-purity iron (99.99+percent) in an atmosphere of helium was recently measured by W. F. Roeser and H. T. Wensel, using an optical pyrometer, and found to be 1,539° ±1° C. The same samples of iron were found to freeze 1° C lower in an atmosphere of hydrogen. In addition, the initial freezing temperatures of some irons of lesser purity and of some steels were measured in an atmosphere of helium to determine the effects of various impurities and alloying elements. The results of measurements on 23 samples of irons and steels, together with the chemical analyses, are reported in RP1375 in the April Journal of Research. The freezing-point depressions of the various elements are listed in a table which may be used to calculate the initial freezing temperatures (liquidus points) of iron or steel containing many combinations of 17 elements, which include all those generally found in commercial irons and steels.

The samples containing less than 0.1 percent of impurities were melted in beryllium oxide crucibles, and the other samples, in all but two cases, were melted in crucibles of aluminum oxide. Temperatures were determined by means of an optical pyrometer sighted into refractory blackbodies immersed in the freezing metal.

PROTECTIVE COATINGS FOR PIPE LINES

The American Petroleum Institute recently completed a very comprehensive 10-year test of 19 protective coatings applied to operating pipe lines. The data obtained throw considerable light on the effects of time, soils, and pipeline conditions on bituminous pipe coatings, and show what may be expected from these coatings under different circumstances. Comparisons of the protected pipe with adjacent unprotected sections show conclusively that most of the coatings materially reduced corrosion and pit depths. However, no coating afforded complete protection to all pipe to which it was applied. Comparisons of the most recent data with that obtained earlier in the same test show that there is a continual decrease in the effectiveness of the coatings. In most cases this appears to be the result of continued soil stress, pipe movement, and root growths, rather than of chemical changes in the coating. It is probable that imperfect application and accidents in handling the coated pipe account for some of the failures, although the coatings were applied by their makers under conditions more favorable than those often encountered in the field. Since a hundred years of experience with pipe coatings has not resulted in one which completely prevents corrosion, it is suggested that complete protection of a pipe line against corrosion by means of a protective coating should not be attempted, but that a reasonably good and inexpensive coating should be applied when the line is laid. If, later, serious corrosion appears at a few points, this can be stopped by the use of cathodic protection.

CANS FOR FRUITS AND VEGETABLES

Simplified Practice Recommendation R155–37, has been superseded by a new edition, R155–40, Cans for Fruits and Vegetables (Names, Dimensions, Capacities, and Designated Use), effective from September 1, 1940.

This new list of can sizes, as developed by the Committee on Simplification of Containers of the National Canners Association, is based on a thorough survey of the canning industry. The list, which is particularly notable for the fact that it identifies the cans which are to be used for each specific commodity, includes 39 cylindrical-can sizes, and 2 square-can sizes, of specified dimensions. Of these, each of 19 is of special dimensions designated for use exclusively with a single commodity. The other 22 cans are recommended for use with from 2 to 57 different designated commodities. Certain of the can sizes are for use with each of the 25 classifications of fruits and 33 classifications of vegetables.

It is significant that this list is based on the can sizes *actually* used by the industry, as illustrated by the fact that 90 percent of the 1939 pack was in 18 of these can sizes, 88.8 percent in 14 of these sizes, and 85 percent in less than 10 of these sizes.

In addition to the simplified list of recommended can sizes, this publica-

tion includes a brief history of the development of the recommendation and lists the members of the standing committee as well as the acceptors of the recommendation. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

REVISED SIMPLIFIED PRACTICE RECOMMENDATIONS FOR PAPER BOXES

Simplified Practice Recommendations R126–41, Set-Up Paper Boxes, and R127–41, Folding Paper Boxes (used by department and specialty stores), are the first revisions of these programs, and became effective January 1, 1941.

Originally promulgated 10 years ago, these recommendations established a simplified list of 194 sizes of set-up boxes and 59 sizes of folding boxes for department and specialty store use. A field survey covering actual methods and materials used by the stores in wrapping and packing merchandise provided the basic information for their preparation.

In 1938 the standing committee decided, in view of changes in packaging practice resulting from changes in sizes, types, and folding methods of merchandise, to revise R126 and R127; and initiated surveys similar to those originally made. These surveys, undertaken jointly by the Division of Simplified Practice and the Store Management Group of the National Retail Dry Goods Association, in collaboration with the standing committee, were accomplished by means of questionnaires and assembled meetings of the committees. From the information thus obtained revised simplified lists of box sizes were developed, which the standing committee is confident will adequately satisfy all normal store requirements.

The 75 sizes of set-up boxes and the 23 sizes of folding boxes now recommended represent reductions of 97 and 96.5 percent from the 2,849 and 683 sizes reported in the current surveys, and a decrease in both cases of 61 percent from the 194 and 59 sizes, respectively, that were formerly listed. Construction and material specifications have been added to increase the usefulness of the recommendations.

In addition to the simplified schedules, the printed recommendations will include a summary of the development of the projects, and lists giving the members of the standing committee and the acceptors of the recommendations.

Until printed copies are available, free mimeographed copies can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

TABLES OF SINE, COSINE, AND EXPONENTIAL INTEGRALS

A new volume of mathematical tables bearing the above title has been made available through the Bureau, which is acting as sponsor for a project conducted by the Federal Works Agency, Work Projects Administration for the city of New York. The volume is bound in buckram and contains 470 pages. The price is $2.00. Remittances should be made payable to and sent to the National Bureau of Standards, Washington, D. C. Payment in advance is required.

The functions tabulated in this volume, which are given to 9 places of decimals from 0 to 2 at intervals of 0.0001, are encountered in many fields of pure and applied mathematics. In the bibliography, references are given to papers in which these functions have been applied to the solution of problems in electrical engineering, chemistry, physics, and biology. They have been selected primarily to show the variety of applications of these functions and to indicate the great frequency with which they occur in recent publications. A short list of reference texts and of the best-known tables of these functions, previously published by other authorities, is included.

NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH 1941

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 26, number 2, February 1941 (RP1362 to RP1367, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers [2]

[Reprints from December 1940 and January 1941 Journal of Research]

RP1346. Mutual inductance of two helices whose axes are parallel. Chester Snow. Price 10 cents.

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $3.50 per year (to addresses in the United States and its possessions, and to countries extending the franking privilege); other countries, 70 cents and $4.50, respectively.

RP1347. Effect of low temperatures on the properties of aircraft metals. Samuel J. Rosenberg. Price 10 cents.
RP1348. A photometric procedure using barrier-layer photocells. Louis E. Barbrow. Price 5 cents.
RP1349. Some properties of the pore system in bricks and their relation to frost action. Ray T. Stull and Paul V. Johnson. Price 10 cents.
RP1350. Standard electrode potential of sodium. Edgar Reynolds Smith and John Keenan Taylor. Price 5 cents.
RP1351. Preparation of benzoic acid of high purity. Frank W. Schwab and Edward Wichers. Price 5 cents.
RP1352. Effect of composition and other factors on the specific refraction and dispersion of glasses. John C. Young and Alfred N. Finn. Price 5 cents.
RP1353. Strength and elongation of silk yarns as affected by humidity. E. Max Schenke and Howard E. Shearer. Price 5 cents.
RP1357. Preparation of *d*-mannose. Horace S. Isbell. Price 5 cents.
RP1360. Combination of silk fibroin with acid and with base. Leland F. Gleysteen and Milton Harris. Price 5 cents.
RP1361. Thermal expansion of electrolytic chromium. Peter Hidnert. Price 5 cents.

Building Materials and Structures Reports [2]

[Persons who wish to be notified of new publications in the Building Materials and Structures series as soon as they are available should write to the Superintendent of Documents, Government Printing Office, Washington, D. C., asking that their names be placed on the special mailing list maintained by him for this purpose.]

BMS64. Solar heating of various surfaces. Herman V. Cottony and Richard S. Dill. Price 10 cents.
BMS69. Stability of fiber sheathing boards as determined by accelerated aging. Daniel A. Jessup, Charles G. Weber, and Samuel G. Weissberg. Price 10 cents.

Simplified Practice Recommendations [2]

R89–40. Coated abrasive products. (Supersedes R89–36). Price 5 cents.
R101–40. Metal partitions for toilets and showers. (Supersedes R101–29.) Price 5 cents.
R155–40. Cans for fruits and vegetables (names, dimensions, capacities, and designated use). (Supersedes R155–37.) Price 5 cents.

[2] See footnote on page 38.

Comercial Standards [2]

CS90E–41. Crawler mounted, revolving power shovels, lifting cranes, dragline and clamshell excavators (export classifications). Price 5 cents.

Miscellaneous Publications [2]

M168. Protection of documents with cellulose acetate sheeting. B. W. Scribner. Price 5 cents.
Annual Report of the National Bureau of Standards for the fiscal year ended June 30, 1940. (Reprint from the Annual Report of the Secretary of Commerce, 1940.) Free on application to the Bureau.

Technical News Bulletin [2]

Technical News Bulletin 286, February 1941. Price 5 cents.
Technical News Bulletin 287, March 1941. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC625. Electrodeposition: Publications by the staff of the National Bureau of Standards. (Supersedes LC566.)
LC627. The care of floors. (Supersedes LC388.)
LC628. Colorimetry and spectrophotometry: Publications by the staff of the National Bureau of Standards. (Supersedes LC398.)
LC630. Bluing of iron and steel.
LC631. Sun lamps, health lamps; carbon and mercury arc lamps. (Supersedes LC462.)
LC634. Rubber: List of publications by the staff of the National Bureau of Standards. (Supersedes LC532.)

RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [3]

A micromanometer with illuminated water-surface locators. F. C. Morey. Instruments (1117 Wolfendale St., Pittsburgh, Pa.). 14, No. 2, 37 (February 1941).

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

Temperature: Its measurement and control in science and industry. The following sections by members of the Bureau's staff have been contributed to this book: Temperature, H. T. Wensel; Slopes of the PV isotherms of some thermometric gases at pressures below two atmospheres, C. S. Cragoe; A practical temperature scale below the oxygen point and a survey of fixed points in this range, H. J. Hoge; Reproducibility of the ice point, J. L. Thomas; Precision resistance thermometry, E. F. Mueller; Thermoelectric thermometry, W. F. Roeser; The calibration of thermocouples at low temperatures, R. B. Scott; Liquid-in-glass thermometers, J. Busse; Precise measurement of the freezing range as a means of determining the purity of a substance, F. W. Schwab and E. Wichers; Methods of testing thermocouples and thermocouple materials, W. F. Roeser and H. T. Wensel; Control and measurement of temperature under the microscope, C. P. Saylor; Concepts of temperature in electric discharge phenomena, F. L. Mohler; Thermometers for aircraft, W. G. Brombacher; Temperature measurement of red brass (85–5–5–5) during melting and casting, H. B. Gardner (research associate, Non-Ferrous Ingot Metal Institute); and The stability of base metal thermocouples in air from 800° to 2,200° F., A. I. Dahl. (Reinhold Publishing Corporation, 330 W. 42d St., New York, N. Y.) (1941).

Extension of pack method for compressive tests. C. S. Aitchison. Nat. Advis. Com. Aero. Technical Note 789 (National Advisory Committee for Aeronautics, Washington, D. C.). (December 1940).

Fire hazard in sterilization by diethylene glycol. L. B. Tuckerman. Science (Science Press, Lancaster, Pa.) **93**, No. 2411, 257 (March 14, 1941).

The optical properties of rubber. Lawrence A. Wood, J. Applied Physics (175 Fifth Ave., New York, N. Y.) **12**, 119 (February 1941).

Microscopic structure of the cotton fiber. Charles W. Hock, Robert C. Ramsay, and Milton Harris. Textile Research (65 Franklin St., Boston, Mass.) **11**, 200 (February 1941); and Am. Dyestuff Reporter (90 William St., New York, N. Y.) **30**, 53 (February 1941).

Accelerated weathering of transparent plastics. G. M. Kline, W. A. Crouse, and B. M. Axilrod. Proc. Am. Soc. Testing Materials (260 So. Broad St., Philadelphia, Pa.) **40**, 1256 (1940).

Sorption of water by plastics. G. M. Kline, A. R. Martin, and W. A. Crouse. Proc. Am. Soc. Testing Materials, **40**, 1273 (1940).

Observations on the tarnishing of stainless steels on heating in vacuo. V. C. F. Holm, in Surface Treatment of Metals. (Am. Soc. for Metals, 7016 Euclid Ave., Cleveland, Ohio) (1941)

Note on moisture expansion of ceramic whiteware in storage and in service. R. F. Geller and A. S. Creamer. J. Am. Ceramic Soc. (2525 North High St., Columbus, Ohio) **24**, 77 (March 1941).

A narrow gauge live steamer. Hugh G. Boutell. The Model Railroader. (Kalmbach Publishing Co., 1568 W. Pierce St., Milwaukee, Wis.) **8**, 146 (March 1941).

The National Bureau of Standards. Lyman J. Briggs. Toledo Business (and similar publications of chambers of commerce of other cities. Address: Community Service Corporation, Hotel Continental, Kansas City, Mo.) **19**, 21 (February 1941).

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